ACE-41 Revised
7/1/41

Information
on the
REGIONAL LABORATORIES FOR RESEARCH ON UTILIZATION OF FARM PRODUCTS
Bureau of Agricultural Chemistry and Engineering
United States Department of Agriculture

The establishment of four regional laboratories was authorized by Section 202 of the Agricultural Adjustment Act of 1938. Under this section the Secretary of Agriculture was authorized and directed to "establish, equip, and maintain four regional research laboratories, one in each major farm producing area, and, at such laboratories to conduct researches into and to develop new scientific, chemical, and technical uses and new and extended markets and outlets for farm commodities and products and byproducts thereof. Such research and development shall be devoted primarily to those farm commodities in which there are regular or seasonal surpluses, and their products and byproducts." The Bureau of Agricultural Chemistry and Engineering administers the laboratories for the Department.

Locations of Regional Laboratories

After a careful survey of many possible sites, locations for the laboratories were decided upon, and the laboratories are now permanently situated, as follows:

Northern Regional Research Laboratory,
825 N. University Street,
Peoria, Ill.

Southern Regional Research Laboratory,
2100 Robert E. Lee Boulevard,
New Orleans, La.

Western Regional Research Laboratory,
800 Buchanan Street,
Albany, Calif.

Eastern Regional Research Laboratory,
Wyndmoor, Pa.
Mailing address: Chestnut Hill Station,
Philadelphia, Pa.

Laboratory Buildings

Construction work was started on all four laboratories during June 1939, and the buildings are now completed. The general design and layout of all four buildings are similar. They are U-shaped structures of three stories and basement, with separate power-plant buildings. Each laboratory building is divided into an administrative unit forming the base of the U; chemical laboratory wing, housing the research laboratory; and an industrial laboratory wing for semi-plant-scale process development.

Commodities Assigned for Initial Study

The following commodities have been selected to receive initial attention in the research programs of the four regional laboratories:

Northern Area
- Corn
- Wheat
- Agricultural Residues

Southern Area
- Cotton
- Sweetpotatoes
- Peanuts

Western Area
- Fruits
- Vegetables
- White Potatoes
- Wheat
- Alfalfa
- Poultry Products and Byproducts

Eastern Area
- Tobacco
- Apples
- White Potatoes
- Milk Products
- Vegetables
- Animal Fats and Oils
- Tanning Materials, Hides and Skins

Personnel

The Directors of the four regional laboratories were appointed on January 1, 1939. They are:

Dr. O. E. May, Northern Regional Research Laboratory
Mr. D. F. J. Lynch, Southern Regional Research Laboratory
Dr. T. L. Swenson, Western Regional Research Laboratory
Dr. P. A. Wells, Eastern Regional Research Laboratory

Appointments have been and will be made until the staffing of the laboratories is completed. Services of organic, physical, and analytical chemists and others, in the fields of carbohydrate, protein, oil, and cellulose chemistry, and chemical engineering, as well as in a number of other fields, are required.

All positions in these laboratories are being filled by selection from lists of eligibles furnished by the United States Civil Service Commission or by reinstatement or transfer of persons having an appropriate civil service status. New examinations will be announced as required. For professional, scientific, and other high grade technical positions examinations are generally country wide. Widespread publicity is given to them — through newspapers, magazines, and other periodicals; through notices posted in all first- and second-class post offices; through notices to institutions of learning and professional, scientific, industrial, and other organizations, and by other means. Persons upon request may have their names placed on the mailing list of the Civil Service Commission, Washington, D. C., to receive notice of the next examination announced for the position in which they are interested, provided it is one in the classified service for which competitive examinations are given. Care must be taken to give the name of the position, in making the request. Notice is sent if the examination is announced within three years.

The research laboratories will also have on the staff such positions as clerical, mechanical, custodial, etc. Any examinations for these classes of positions are usually held locally. Eligible lists already existing may be used in filling vacancies, where appropriate.

July, 1941.

UNITED STATES DEPARTMENT OF AGRICULTURE
Bureau of Agricultural Chemistry and Engineering

Carbohydrate Research Division

CARNAUBA WAX

Carnauba wax is obtained from the leaves of the palm Copernicia cerifera, which is found chiefly in Brazil in the states of Ceara, Piauhy, Parahiba, Rio Grande, do Norte, and Maranhao. The palm produces the wax only in those regions which have long dry periods.

The crop is gathered from September to March. From each palm six leaves not yet fully opened are cut off with pruning shears attached to a long pole. The leaves are cut from each palm two or three times during the harvesting season. These are graded into first and second qualities, and placed in direct sunlight to dry for three days. Then they are collected and placed in storage buildings until the wax can be removed from them. In a tightly closed room as much as possible of the wax is brushed from the dried leaves and a further recovery is made by beating them with switches. The wax is collected from the floor and transferred to tubs or vats half full of boiling water. After the wax has gathered in a mass on the surface of the water, it is removed and placed in coarse-mesh cotton cloths in order to separate the adhering water. When dry, the crude wax is a dull green or yellowish brittle mass. The wax is refined by melting it in hot water and slowly stirring with a paddle to facilitate the separation of plant debris. For further refining, it can be melted and filtered through a heated filter press. Sometimes before filtering, it is thoroughly mixed with 5 percent or more of bleaching earth. This treatment produces the yellow grades of the wax.

The commercial grades of the wax are as follows: No. 1 and No. 2 Yellow, No. 2 and No. 3 North Country, and No. 3 Chalky. The wax is used chiefly in the manufacture of various kinds of polishes, leather finishes, phonograph records and certain lacquers.

The wax melts at 80° to 86° C., gives an iodine number from 12 to 15, a saponification value from 67 to 88, and an acid value from 2 to 7.

Additional information on carnauba wax will be found in the following publications:

"Waxes: Animal, Mineral, Vegetable and Synthetic" by Ibert Mellan, Chemical Industries, vol. 37, pp. 539-545 (1935).

"Waxes: A Brief Study of the Polishing Waxes" by M. J. Hausman, Soap, vol. 12, No. 8, pp. 95-97 (1936).

"Chemical Technology and Analysis of Oils, Fats, and Waxes" by J. Lewkowitsch (3 volumes), published by MacMillan & Co., 1923.

Many city libraries, as well as those of agricultural experiment stations and universities, have these publications.

(ACE-43)

FIRE AND EXPLOSION PROTECTION AT COUNTRY GRAIN ELEVATORS

Address by
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Association of American Railroads
Atlantic City, N. J.
May 8, 1940

The isolated country grain elevator located along the railroad in or near a small settlement is a serious fire hazard. It is generally the largest building in the community. The seriousness of the hazard is due both to the nature of the business and the fact that local fire fighting facilities are usually totally inadequate to cope with a fire in such a large building. There are about 10,000 grain-handling plants classified as country elevators and they have a capacity of about 500,000,000 bushels. Some of these are owned by the railroads, others are owned and operated by large terminal grain companies and many are owned and operated by cooperative associations. Reports of the Farm Credit Administration indicate that there are 2,600 Farmers' Cooperative Elevator Associations with 360,000 members that do a business of $475,000,000 a year. Practically all plants are located along railroads and many are on railroad land or adjoin railroad property.

FIRE AND EXPLOSION LOSSES

The exact number of country elevators destroyed by fire or explosion each year is not known and estimates of the amount of the loss vary considerably. The best information available indicates that last year, 1939, there were about 150 dust fires and explosions in country grain plants with a loss of about $3,000,000. A study of the hazard has been undertaken by the Dust Explosion Hazards Committee of the National Fire Protection Association which was organized in January, 1922 and reorganized in 1926 in order to qualify as a sectional committee of the American Engineering Standards Committee, now the American Standards Association. The U. S. Department of Agriculture and the National Fire Protection Association act as joint sponsors of the committee.

SCOPE OF THE COMMITTEE WORK

The committee is entrusted with the development of methods of preventing dust explosions in connection with processes and industries producing combustible or explosive dusts, including measures for the prevention of ignition, restriction of potential damage by proper construction and arrangement of buildings, restriction of the production and escape of dust through the control of dust-producing processes and equipment, extinguishment methods, and related features. Fire prevention and extinguishing are included since dust explosions may result from fire.

WORK OF THE COMMITTEE

Eleven safety codes for the prevention of dust explosions in specific industries have been prepared by the committee and approved as American Standards. Other codes are in the course of preparation and to meet the need for some general information on dust explosion prevention suitable for industries which now have no specific codes the committee has compiled a set of general recommendations known as, "Fundamental Principles for the Prevention of Dust Explosions in Industrial Plants."

With the cooperation of the country grain elevator associations an attempt is now being made to compile a set of recommendations that will provide for proper protection against the dust explosion hazard in the thousands of small grain-handling plants scattered throughout the country. These recommendations are still in the tentative stage because of the difficulty encountered in preparing a set of rules which will be applicable and practicable in the many different types of plants now in operation. Buildings are of frame, metal, tile and concrete construction with the same wide variation in types of equipment installed. Many plants have feed grinding equipment in addition to storage facilities and frequently the operators act as distributors for feed, fertilizer, building material and farm machinery. Warehouses, corn cribs and sheds adjoin the main elevator building in many cases and all of these conditions must be considered in planning adequate protection for the plant.

Small elevators are subject to the same dangers as large ones, because all grain dusts explode under certain conditions and the problem of providing proper protection becomes one of recommending the safest procedure under operating practices peculiar to this type of plant. An analysis of fire losses in country grain elevators shows that practically all are preventable and owners and operators are urged to avail themselves of the latest information on fire prevention. In many cases a small fire may result in a dust explosion which spreads the flames throughout the building and causes a complete loss.

GENERAL PRECAUTIONS

There are certain generally accepted recommendations for fire and explosion prevention which should be adopted pending the preparation of a specific code for country elevators. Some of these recommendations are listed below:

1. Non-combustible construction is recommended.

2. Combustible elevators should be metal-clad.

3. Frame elevators of heavy crib construction are preferable to the lighter types.

4. Partitions should be of heavy construction preferably of non-combustible material.

5. Hazardous areas should be cut off with walls of heavy planks or non-combustible material.

6. Stairs and wells should be inclosed or cut off from hazardous areas.

7. Feed grinding or milling operations should be conducted in a separate building or segregated section of the plant.

8. Ledges and beams or other lodging places for dust should be eliminated.

9. Bins should be covered but vented to the outside to prevent dust dissemination throughout the house.

10. Equipment should be as dust-tight as possible.

11. Cleanliness is of prime importance and the prevention of dust accumulations is essential.

12. Large window area should be installed and cross ventilation provided wherever possible.

13. Equipment should be non-combustible and maintained in good operating condition.

14. Electricity is recommended for lighting and power with all equipment selected and installed to conform to the National Electrical Code requirements for dusty locations.

15. Only low pressure steam or similar heating equipment incapable of igniting dust clouds should be used in operating parts of the plant.

16. Protection against lightning should be provided.

17. Smoking should be prohibited.

18. Grounds around the plant should be kept clear of high weeds and rubbish which might become ignited and permit the flames to spread to the elevator.

19. Screens should be provided at points where grain is received to catch any foreign material such as stones and scrap iron.

20. Anti-friction bearings are recommended.

21. Fire extinguishers, casks and pails or similar equipment should be placed throughout the plant and maintained in good operating condition.

22. A loud alarm or some other effective means of calling for assistance in case of fire should be provided.

GRAIN DRIERS

Many small houses have recently installed grain drying equipment and special precautions should be taken to see that such apparatus is properly installed and carefully operated.

1. Driers should be placed in a separate fire-resistive division, separated from elevator or tanks by as much space as practicable.

2. Louvers, or other permanent openings where air enters or is exhausted from buildings, should be protected by substantial corrosion-resistive wire screens, not exceeding one-fourth inch mesh, to exclude sparks, birds, paper, etc.

3. Garner, hopper, or bin over drier and same under cooling section should be dust-tight and provided with effective vents to outside.

4. All grain should pass over a coarse screen immediately ahead of drier to remove cobs, paper, sticks, etc.

5. Fans should conform to the National Fire Protection Association Regulations for the Installation of Blower and Exhaust Systems for Dust Stock and Vapor Removal.[1] The requirement for nonferrous parts should apply, unless blowing only air taken from outside building through continuous tight duct.

6. Steam coils should be so designed, installed, and arranged that dust will not lodge on coils, headers, or elsewhere in casing containing same. Coil room should be separated by dust-tight partitions and floors from drying section and all other parts of drier house.

7. Spouts between the drier building and other buildings should be of metal and equipped with approved dampers.

8. Fire-heated driers.--(a) The drier furnace should be located in a fire-resistive room or division separated from the drier columns and fans and the plant proper by masonry walls with no communication except the ducts leading from furnace to the drier fans carrying products of combustion.

(b) Fire-heated driers should be provided with reliable automatic means for regulating the temperature in the drying columns, which should consist of two independent control systems consisting of:

(1) An automatic control system designed to hold the temperature within predetermined limits at the discretion of the operator; and

(2) An emergency control system which will operate when the temperature in the drying column reaches a dangerous point by permitting the entrance of cold air into the drying columns.

(3) Where such temperature controls are operated by air pressure, suitable means should be provided to stop the drier fans automatically in case of air failure caused by leaking of broken air lines or other reasons.

(c) In addition to the automatic temperature controls required in the preceding paragraphs, suitable visual thermometers should be provided. One of these should preferably be of the extension dial type with the dial located at a point near the firing end of the furnace so as to be in plain sight of the operator.

(d) The temperature control systems for fire-heated driers should be kept in proper operating condition at all times when the drier is in use.

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1. Obtainable from the National Fire Protection Association, 60 Batterymarch St., Boston, Mass.

(e) When coal or coke is used as fuel for fire-heated driers, due consideration should be given to the proper storage of these fuels and the disposal of their ashes. When gas is used as the fuel, it is important that the piping system be properly installed with tight joints to prevent leakage. In addition to the gas control valves located at the drier furnace, there should be provided an additional valve outside of the buildings in an accessible place to permit shutting off the gas supply to the furnace in case of emergency. When oil is used for fuel, oil burner and fuel storage tanks used in connection therewith should be of approved type and equipped with approved control equipment.

DUST COLLECTION AND REMOVAL

Regulations which prohibit the application of suction before weighing grain entering an elevator prevent the elevator operator from providing adequate protection. It will be necessary to install effective dust collecting and dust control equipment in grain elevators before progress in dust explosion control in this industry comparable to that in milling plants can be made.

To provide effective dust control it is necessary to: (1) prevent the formation of dust clouds by applying suction at the point where the dust is produced; (2) remove all dust accumulations promptly; and (3) provide thorough ventilation for building and equipment.

Many small elevator operators feel that they cannot afford to install dust control equipment, but it is well to remember that a dust-free mill or elevator is explosion proof and the installation of an effective dust collecting system will provide protection against a hazard capable of causing the complete destruction of the plant.

In order to obtain the best information possible on desirable protective measures for country elevators an advisory committee consisting of:

Capt. L. C. Webster, Minneapolis, Minn.
J. F. Moyer, Dodge City, Kansas
Fred Sehl, Indianapolis, Ind.
Ted Brash, Spokane, Wash.

has been appointed by the country elevator associations to assist in preparing a dust explosion prevention code. This committee will present their recommendations to a subcommittee of the Dust Explosion Hazards Committee consisting of:

Hylton R. Brown, Washington, D. C.
Eugene Arms, Chicago, Ill.
G. R. Hurd, " "
K. H. Parker, " "
Capt. L. C. Webster, Minneapolis, Minn.

In this way it is planned to get into the code the information which will permit the operator or owner to provide the desired protection against the

fire and explosion hazard at his plant. Any specific recommendations which it is felt should be included in the code should be submitted to the advisory committee or directly to the Dust Explosion Hazards Committee. Such suggestions will be appreciated and through the cooperation of all interested parties it will be possible to prepare a workable, acceptable code which will effectively protect the small country grain-handling plant against the fire and dust explosion hazard.

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ACE-44

General Information on the Chemistry of Eggs and Egg Quality Investigations

By
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Hens' eggs had been an important food for man for thousands of years before the coming of modern biological chemistry. They have been extensively studied and analyzed by biologists and chemists during the past 50 years. An egg is made up of an outer protein film called the bloom, two layers (not readily separated) of shell, two shell membranes, three layers of white, the yolk membrane or vitelline membrane, and the yolk, which contains the germ or blastoderm. Diet has very little effect on the composition of eggs, except on the vitamin content, which is affected greatly. Fresh eggs vary in size and relative content of the various parts due to age of the hen, feed, breed, weather conditions, etc., but average about 57 grams (2 ounces) in weight. This weight is divided approximately as follows:

Shell .... 12%   White .... 56%   Yolk .... 32%.

The secretion that lubricates the passage of the egg during laying dries to form the bloom. The shell and yolk membranes are protein substances (keratin) resembling feathers and hair in composition. These keratins are of no food value. The shell is composed of around 94 percent calcium carbonate, 1 percent magnesium carbonate, and 4 percent organic matter, chiefly protein. The thick white is distinguished

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from the two thin fractions by its content of a jelly-like protein, ovomucin, that holds the other proteins in a weak gel.

The chemical compositio n of the edible portion averages about as follows:

	Water %	Protein %	Fat %	Ash %
White	86	13	0.2	0.6
Yolk	50	16	33.	1.1
Whole egg	74	14	12.	0.8

Small amounts, about 0.5 percent, of carbohydrates are also present.

The proteins of the white have been separated quantitatively by M. Sorenson (Biochem. Zeit., 269, 271 (1934)). He summarizes his results as follows: globulin, about 7 percent; mucin, about 2 percent; albumin, about 70 percent; conalbumin, about 9 percent; mucoid, about 13 percent. The yolk proteins are difficult to separate and are not so fully known; a phosphorus-containing protein ovovitellin, a globulin-like ovolivetin and a nuclein are known to be present, also lecitho-protein or phospho-lipin.

The excellent food value of eggs from the standpoint of protein and fat content is increased by the vitamins present. Egg yolk is one of the best sources of vitamins A, B and G (B_2) available in our diet, and egg white contains about half as much vitamin G as the yolk. Vitamin E is also present in the yolk, but no satisfactory method of assay for this vitamin is known. The value of eggs as a food is best shown by the fact that the complete healthy chick is produced on egg alone.

Chemists and technologists have also conducted numerous investigations of the best methods of storing, drying, freezing and thawing eggs. Measurement of the appearance of the broken-out egg has been exactly worked out, and the results of such studies have been applied to commercial practices. Volume III of Winton and Winton's "Structure and Composition of Foods", John Wiley & Sons, 1937, contains an excellent 50-page review of the chemistry of eggs. Sharp, in Food Research, vol. 2, page 477 (1937), reviews the investigations on egg storage to that date. Swenson has summarized the research and publications of the U. S. Bureau of Chemistry and Soils on the vacuum-CO_2 oiling process for preserving eggs in commercial storage. This summary may be obtained from the Food Research Division, Bureau of Agricultural Chemistry and Engineering.

Information on Egg Quality

An egg is a perishable commodity in which chemical and physical changes are taking place from the time it is laid until it is eaten. The consumer is interested in accurate detection of these changes, because he wants to obtain the full quality for which he pays. The producers and handlers of eggs have shown great interest in improving the methods of transporting and storing eggs. Because of this universal interest many investigators have endeavored to measure the changes in the condition or interior quality of eggs. The methods developed can be conveniently divided into candling of whole eggs and breaking out for visual inspection. There have been attempts to develop methods other than candling to judge the quality in unbroken eggs, but none of these has been very successful as yet.

Candling

The oldest and most valuable method for commercial purposes is candling. The ancient Egyptians used the sun's rays passing through a hole in the wall of a darkened room to separate infertile from fertile eggs. As early as 1849 commercial candling to eliminate bad eggs was practiced in this country. There was a gradual development of candling in succeeding years and in the last 25 years the practice has been greatly extended. U. S. and State grades have been developed and an inspection service is maintained in all the principal producing areas and markets.

A typical candling outfit consists of a 20- to 50- watt bulb enclosed in a box that has a hole about the width of an egg in the side. When an egg is held before the candle in a darkened room, the position of the yolk and the size of the air cell can be seen. Eggs of high quality have a small air cell, and the yolk is centered well in the egg and does not appear to move when the egg is rotated in the hand. As the egg deteriorates the air cell becomes larger, and the yolk becomes more visible, sinks lower in the shell, and rotates freely when the shell is rotated.

An experienced candler has no difficulty in eliminating eggs that have developed rots or have started development of the embryo chick. Eggs that have been stored for some time or those exposed to high temperature and low humidity for a short time can also be distinguished. These distinctions are made according to standards set up as a result of wide experience. Copies of the current U. S. standards can be obtained from the Agricultural Marketing Service, U. S. Department of Agriculture. The various State standards agree closely with

the U. S. standards and in many states are identical. Copies of the regulations in any particular state may be obtained from the State Department of Agriculture or the State Agricultural Experiment Station.

Broken Out Quality

During the past 10 years there have been developed several methods for measuring exactly the appearance of the egg when broken out on a flat plate. An absolutely fresh egg has a round, even colored yolk surrounded by a jelly-like bag of white called thick or firm white. Inside this bag of thick white is a layer of thin white, and an outer layer of thin white surrounds the thick white. As the egg ages, the thick white weakens and spreads out, the weaker gel breaks readily, and the inner thin white escapes. Finally, in eggs that are badly broken down the thick white practically disappears. The yolk membrane also becomes progressively weaker and the yolk flattens out and breaks easily during the later stages of breakdown.

Sharp and Powell (Ind. Eng. Chem., 22, 908 (1930)) proposed the ratio of the height to the width of the yolk, or the yolk index, as a quantitative measure of the breakdown of the yolk. Holst and Almquist (Hilgardia, 6, 49 (1931)) proposed the percentage of the thick white as a measure. These two methods are of value in many investigations, but they indicate only gross changes in the quality of the eggs.

A set of 9 pictures that illustrate the successive steps in the spreading out of the white was prepared by Van Wagenen and Wilgus in 1935 (Jour. Agr. Res., 51, 1129). Eggs can be compared with these

pictures and scored accordingly. This photographic scoring technique is very simple and rapid, and the method has been used successfully in many investigations.

Laboratory workers, however, have felt the need of more exact methods which can be used in studying processing operations, developing a more exact method of candling, etc. The use of a vertical caliper to measure the height of the white was developed almost simultaneously at Washington State College (Poultry Science, 15, 141 (1936)) and at Cornell University (Poultry Science, 15, 319 (1936)).

Parsons and Mink (U. S. Egg & Poultry Mag., 43, 484 (1937)) compared the methods in use at that time and found that the area of the thick white showed fairly good correlation with the photographic score.

Hoover (Jour. Assoc. Off. Agr. Chem., 21, 496 (1938)) simplified the method of measuring this thick white area. The egg is broken onto a wooden plate marked with rings at various distances from the slightly concave center. The length and width of the thick white can be read off and the area determined from charts prepared for this purpose.

It can be seen that these later methods are attempts to measure exactly the appearance of the egg. By the use of such methods a great deal of fundamental data on the best conditions for producing and storing eggs has been obtained. The comprehensive bibliography on this subject compiled by Wilhelm (U. S. Egg & Poultry Mag., 45, 563 (1939)) contains more than 300 references. It was followed in subsequent issues by a comprehensive review of the articles cited in the bibliography and

anyone wishing detailed information on any particular phase of the subject should refer to this compilation and review.

Applications of the methods discussed above to various practical problems are made in a group of papers by Wilhelm, Haugh, Van Wagenen, Hall and Altmann, Hoover and Rogers, and others that were presented at the Seventh World Poultry Congress, 1939, and are published in the Proceedings of that meeting (Seventh World's Poultry Congress and Exposition, Proceedings. Section 6, Poultry Products Research).